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GB 0844413 A EP 0255359 A2 US 5555915 A
US 4230899 A

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(54) Abstract Title
Current-carrying vacuum cleaner hose assembly

(57) The hose assembly has at least two conductors 4 and 5 extending helically around the hose and joined at opposite ends to electrical connectors. One conductor 4 has a solid metal core 11 and provides the major strength of the hose, urging it into an axially retracted state. The other conductor 5 has a lighter, stranded wire 13. An outer layer 10 of a flexible insulating material is bonded to insulating sleeves 12 and 14 on the conductors 4 and 5 and folds between adjacent turns of the conductors when the hose is in its natural, retracted state. The hose can be extended to several times its length. Alternatively, both conductors have stranded wire 13 and a solid resilient element, not used for conducting, provides the major strength (Fig.5).

Fig.2.

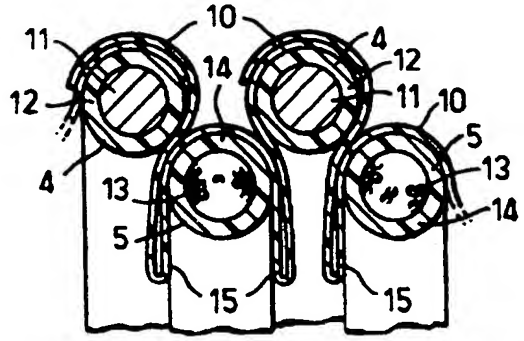

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Fig.1.

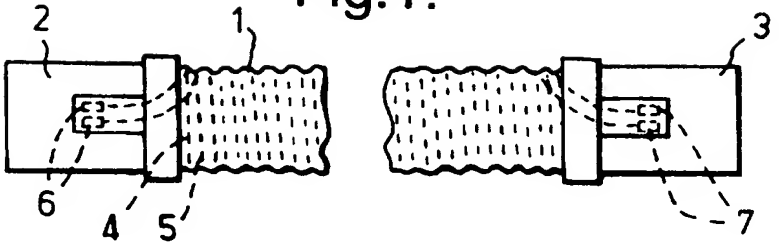


Fig.2.

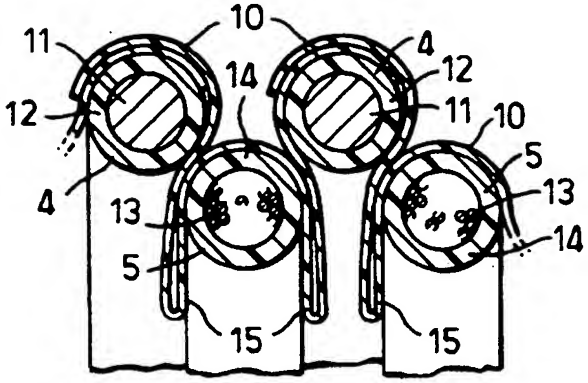


Fig.3.

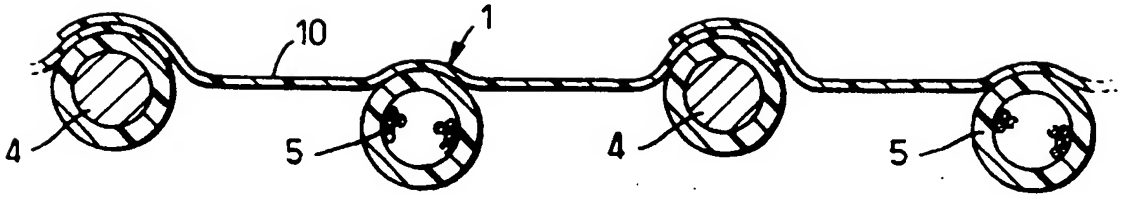


Fig.5.

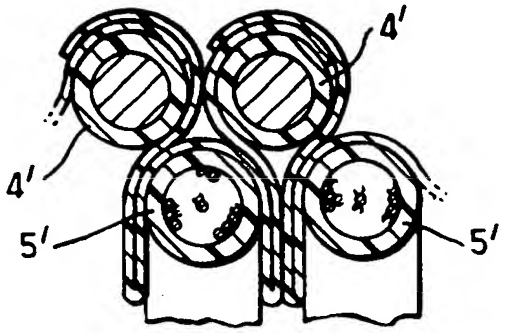


Fig.4.

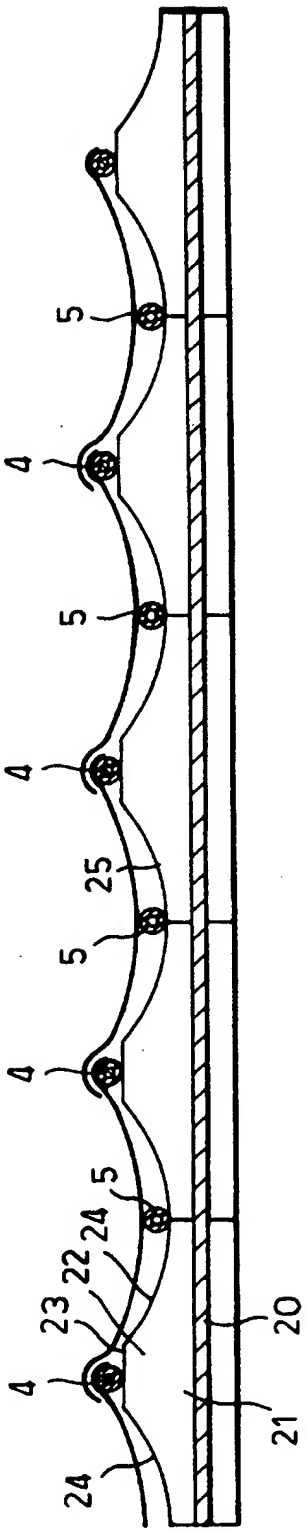
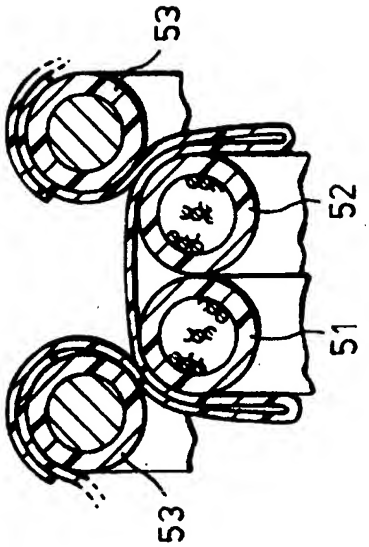


Fig.6.



CURRENT-CARRYING HOSE ASSEMBLIES

This invention relates to current-carrying hoses assemblies.

Current-carrying hoses are used in various applications, such as, in vacuum cleaners, to supply power to a beater head at one end of the hose. These hoses can take various different forms. In US 4162370 there is described a current-carrying hose with an insulated two-conductor wire wound helically and covered with reinforcement yarns and a flexible insulating layer. In US 4354051 the hose is formed from a helically-wound strip of plastics material with interlocking edge portions and a channel in which the conductors are inserted. US 4693324 describes a hose with separate conductors wound helically parallel to one another and covered by outer plastic strips. US 4490575 describes a hose with an insulated two-conductor wire attached to the outside of the hose.

These previous hoses are flexible to a certain extent because, when the hose is bent, the material between the turns of the wire can be folded on the inside of the bend. The length of the hose, however, is substantially fixed, making storage of the hose difficult, especially where the hose is permanently attached to the vacuum cleaner.

It is an object of the present invention to provide an improved current-carrying hose assembly.

According to one aspect of the present invention there is provided a current-carrying hose assembly including a hose comprising first and second helical conductors and a layer of flexible material attached with said conductors, at least the first conductor having a natural axially-retracted state where the layer of flexible material is folded between adjacent turns of the conductors giving the hose a naturally retracted state, such that when the hose is pulled, the flexible material can unfold, enabling the length of the hose to be extended by at least twice its natural length.

The flexible material is preferably folded inwardly between turns of the conductors when the hose is in its retracted state. Each conductor preferably includes an outer insulating sleeve, the conductors extending on the inside of the layer of flexible material. The first conductor preferably has a solid core providing a major part of a resilient force urging the hose to its retracted state. The second conductor preferably has a stranded wire core. The diameters of the two conductors may be different from one another, the first conductor having a larger diameter of winding than the second conductor. The hose is preferably arranged such that a turn of the first conductor abuts an adjacent turn of the second conductor in its natural state. The assembly preferably includes two end fittings, each end fitting being attached to an opposite end of the hose and including an electrical connection with both said conductors. One of said end fittings is preferably adapted for connection to a suction inlet of a vacuum cleaner and the other of said end fittings being adapted for connection to a suction head.

According to another aspect of the present invention there is provided a current-carrying hose assembly including a hose and an electrical connector at opposite ends of the

hose, the hose having a plurality of helically-extending elements and a layer of a flexible material attached with said elements, at least one of said elements being resilient and having a natural axially-retracted state, at least two of said elements being electrically-conductive and being electrically connected with respective electrical connectors at opposite ends of said hose, and the hose being extensible in length from a natural, retracted state with said flexible material folded in regions where it is not attached with said elements, to an extended state where the flexible material is unfolded.

The resilient element is preferably provided by at least one of the electrically-conductive elements.

A current-carrying vacuum cleaner hose assembly according to the present invention, will now be described, by way of example, with reference to the following drawings, in which:

Figure 1 is side elevation view of the hose;

Figure 2 is an enlarged sectional side elevation view of a part of the hose in its natural retracted state;

Figure 3 is an enlarged sectional side elevation view of the same part of the hose as in Figure 2, in an extended state;

Figure 4 is a sectional side elevation view showing manufacture of the hose;

Figure 5 is an enlarged section side elevation view of a part of an alternative hose in its natural state; and

Figure 6 is an enlarged sectional side elevation view of a part of another alternative hose in its natural state.

With reference to Figure 1, the hose assembly comprises a length of retractable, current-carrying hose 1 and end fittings 2 and 3 at opposite ends. The hose 1 has two electrical conductors 4 and 5 extending helically along its length. One end of the conductors 4 and 5 is electrically connected to an electrical connector 6 on the end fitting 2, the other end of the conductors being electrically connected to an electrical connector 7 on the other end fitting 3. The end fitting 2 serves to connect one end of the hose assembly with the suction inlet on a vacuum cleaner (not shown), the other fitting 3 being connected to a suction/beater head (not shown). The electrical connectors 6 and 7 may be of the plug-and-socket, push-fit kind but they could, alternatively, be permanent connections, such as solder joints, where the end fittings are permanently attached with the vacuum cleaner and suction head. The detailed construction of the end fittings is not important to an understanding of the present invention.

Referring now also to Figure 2, the hose 1 comprises the two conductors 4 and 5 and an outer layer 10 of a flexible, electrically-insulative material, such as PVC. The conductor 4 has a solid core 11 of an alloy of high tensile steel and copper with an insulating sleeve 12 of

PVC. The core 11 of this conductor 4 makes it highly resilient. The other conductor 5 has a stranded core 13 of copper, or other conventional conductor, and an insulating sleeve 14 of PVC. This conductor 5 is pliable and flexible, with considerably less strength and resilience than the first conductor 4, but is lighter. The two conductors 4 and 5 are wound helically with the same pitch so that each turn of one conductor lies between adjacent turns of the other conductor. The external diameter of the solid conductor 4 is slightly larger (about 39mm) than that of the stranded conductor 5 (about 34mm).

The layer 10 of PVC is bonded to the insulating sleeves 12 and 14 of the two conductors 4 and 5, being attached around approximately the outer one third of the circumference of the sleeves. Figure 2 shows that, in the natural state of the hose 1, the layer 10 is bent into folds 15 between adjacent turns of the two conductors 4 and 5, projecting inwardly of the hose beyond the inner surface of the stranded conductor 5 by a distance about equal to one half of the cross-section diameter of the conductor.

In this natural state, the hose 1 is retracted, the resilience of the solid conductor 4 applying an axial compression or retraction to the hose so that adjacent turns of the solid conductor abut those of the stranded conductor 5, preventing further compression of the hose. The strength of the solid conductor 4 makes the hose very resistant to crushing.

The hose 1 is readily extended from its natural, compressed or retracted state by pulling its ends away from one another. The hose 1 can be extended to three times its natural length, although this extension factor can be anything from about two to six. This enables the

hose to be stored in a compact space, such as within the vacuum cleaner itself, and yet be extended to a greater length in use.

In its extended state, the hose has the appearance shown in Figure 3. It can be seen that the turns of the two conductors 4 and 5 are now separated from one another and the folds 15 of the layer 10 have flattened. The stranded conductor 5 provides little strength to the hose but is protected from damage because the solid conductor 4 projects outwardly slightly beyond it. Although the conductors 4 and 5 described are only single insulated, it is preferable that they are all double insulated, for safety reasons.

With reference now to Figure 4, the hose 1 is made by helically winding the two conductors 4 and 5 onto a mandrel 20 supporting a profiled, helically-wound belt 21. The belt 21 has a central hill 22 with a flat top 23, and convex slopes 24 extending along either side. When wound on the mandrel, the slopes 24 of adjacent turns of the belt 21 form a valley 25 extending between adjacent turns of the hill 22, the valley and hill both extending helically along the mandrel. The solid conductor 4 is wound on the top 23 of the hill 22 and is given a set curve as it is wound onto the mandrel 20 so that it takes up an axially-compressed or retracted natural state. The stranded conductor 5 is wound along the centre of the valley 25, the two conductors 4 and 5 being spaced from one another on the mandrel 20. The outer layer 10 is applied by wrapping a PVC strip from an extruder on top of the conductors 4 and 5, with edges of adjacent turns of the strip overlapping one another on top of the solid conductor 4. The PVC strip is bonded to the insulating sleeves 12 and 14 on the two conductors 4 and 5 by the application of heat and a solvent. The strip is cooled as it progresses along the mandrel

20 so that it is cured and fully bonded to the conductors 4 and 5 by the time it moves off the end of the mandrel. When this happens, the resilience of the conductor 4 causes the hose to retract to the state shown in Figure 2, with the stranded core conductor 5 lying on the inner side of the windings of the solid conductor 4.

Various modifications are possible. For example, the diameter of the stranded conductor 5' could be made smaller so that, in its retracted state, the adjacent turns of the solid conductor 4' abut one another, and the adjacent turns of the stranded conductor abut one another, as shown in Figure 5. Such a hose may be particularly suitable for low voltage applications where only small diameter conductors are needed.

The hose could have more than two conductors. For example, a third, earth conductor could be included. The solid resilient element need not be used as a conductor, instead, the conductors could be both stranded elements, the solid, resilient element being used solely for mechanical purposes, to retract the hose and give it strength. A hose with two stranded conductors 51 and 52 and one solid resilient element 53 is shown in Figure 6. This could provide a two-conductor hose, with the solid element 53 serving an entirely mechanical role, or it could provide a three-conductor hose, with the solid element also acting as a conductor.

Instead of having the flexible layer on the outside, it could be on the inside of the conductors and be folded to project outwardly between adjacent turns of the conductors in a retracted state.

CLAIMS

1. A current-carrying hose assembly including a hose comprising first and second helical conductors and a layer of flexible material attached with said conductors, wherein at least the first conductor has a natural axially-retracted state where the layer of flexible material is folded between adjacent turns of the conductors giving the hose a naturally retracted state, such that when the hose is pulled, the flexible material can unfold, enabling the length of the hose to be extended by at least twice its natural length.

2. A hose assembly according to Claim 1, wherein the flexible material is folded inwardly between turns of the conductors when the hose is in its retracted state.

3. A hose assembly according to Claim 1 or 2, wherein each conductor includes an outer insulating sleeve, and wherein the conductors extend on the inside of the layer of flexible material.

4. A hose assembly according to any one of the preceding claims, wherein the first conductor has a solid core providing a major part of a resilient force urging the hose to its retracted state.

5. A hose assembly according to any one of the preceding claims, wherein the second conductor has a stranded wire core.

6. A hose assembly according to any one of the preceding claims, wherein the diameters of winding of the two conductors is different from one another.

7. A hose assembly according to Claims 4, 5 and 6, wherein the first conductor has a larger diameter of winding than the second conductor.

8. A hose assembly according to any one of the preceding claims, wherein the hose is arranged such that a turn of the first conductor abuts an adjacent turn of the second conductor in its natural state.

9. A hose assembly according to any one of the preceding claims including two end fittings, wherein each end fitting is attached to an opposite end of the hose and includes an electrical connection with both said conductors.

10. A hose assembly according to Claim 9, wherein one of said end fittings is adapted for connection to a suction inlet of a vacuum cleaner and the other of said end fittings is adapted for connection to a suction head.

11. A current-carrying hose assembly including a hose and an electrical connector at opposite ends of the hose, wherein the hose has a plurality of helically-extending elements and a layer of a flexible material attached with said elements, wherein at least one of said elements is resilient and has a natural axially-retracted state, wherein at least two of said elements are electrically-conductive and are electrically connected with respective electrical connectors at opposite ends of said hose, and wherein the

hose is extensible in length from a natural, retracted state with said flexible material folded in regions where it is not attached with said elements, to an extended state where the flexible material is unfolded.

12. A hose assembly according to Claim 11, wherein said resilient element is provided by at least one of said electrically-conductive elements.

13. A vacuum cleaner hose assembly substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

14. A vacuum cleaner hose assembly substantially as hereinbefore described with reference to Figures 1 to 4 as modified by Figure 5 of the accompanying drawings.

15. A vacuum cleaner hose assembly substantially as hereinbefore described with reference to Figures 1 to 4 as modified by Figure 6 of the accompanying drawings.

16. Any novel and inventive feature as hereinbefore described.

The Patent Office

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Application No: GB 9803801.1 **Examiner:** Roger Binding
Claims searched: 1-15 **Date of search:** 13 May 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F2P (PF14)

Int Cl (Ed.6): F16L 11/118; A47L 9/24

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 0844413 A	(HOOVER), see the embodiment of Fig 2.	1-4, 6-12
X	EP 0255359 A2	(AUTOMATION INDUSTRIES), this is equivalent to referred-to US 4693324.	11
X	US 5555915 A	(KANAO), see Fig 10 and column 5, lines 15 to 28.	11
X	US 4230899 A	(KANAO)	1-3, 5, 11, 12

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.